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SYSTEMS WITH INTERCHANGEABLE HORNS FOR PRODUCING ENCASED PRODUCTS AND RELATED METHODS, COMPUTER PROGRAM PRODUCTS AND HORN ROTOR ASSEMBLIES

Related Application

This application claims priority to U.S. Provisional Application Serial No. 60/501,647, filed September 9, 2003, the contents of which are hereby incorporated by reference as if recited in full herein.

Field of the Invention

The present invention relates to apparatus, systems, methods and computer program products that stuff or fill product into casings that enclose products therein.

Background of the Invention

Conventionally, in the production of consumer goods such as, for example, meat or other food products, the food is fed (typically pumped) or stuffed into a casing in a manner that allows the casing to fill with a desired amount of the product. As is well-known, the casings can be a slug-type natural or artificial casing that unwinds, advances, stretches and/or pulls to form the elongate casing over the desired product. Another type of casing is a heat-sealed tubular casing formed by seaming a thin sheet of flexible material, typically elastomeric material, together. U.S. Patent Nos. 5,085,036 and 5,203,760 describe examples of automated substantially continuous-feed devices suitable for forming sheet material or flat roll stock into tubular film casings. The contents of these patents are hereby incorporated by reference as if recited in full herein.

Despite the foregoing, certain factories and plants desire the capability and/or flexibility to be able to produce products using either type of casing without requiring dedicated equipment space and/or separate production lines dedicated to each type of casing.

Summary of Embodiments of the Invention

Embodiments of the present invention provide apparatus, systems, devices, kits, methods and computer program products configured to allow two types of casings to be output (such as, for example, seamed and unseamed casings) that use corresponding different horns that are filled in a manner that reduces the amount of dedicated equipment and/or equipment space needed to accommodate both types of horns individually, and/or that integrate two production lines into a single production line with interchangeable horn components. The interchangeable horn components can be configured to releasably connect to and/or disconnect from a substantially common support structure and allow the changeover to different horns and different casing types in a manner that minimally disrupts the production line equipment upstream and/or downstream thereof.

In certain embodiments, a first horn and second horn assembly are aligned along a common axial centerline and sized and configured to occupy substantially the same floor space. The first horn can be configured to operate with *in situ* fabricated heat-sealed and seamed elastomeric casings and the second horn can be configured to operate with pre-made casing slugs. The housing of the heat-sealing equipment can remain in location and hold certain components of the second horn assembly when the second horn is in use. The horns and apparatus housing can be configured for a relatively quick changeover of casing/horn type (typically on the order of less than about 15 minutes).

Embodiments of the invention are directed to methods for producing encased products using selectable first and second horns to thereby produce products in selectable different casing types. The methods include: (a) providing an apparatus having a first horn that, in operation, is configured to be in fluid communication with a filler pump located upstream thereof; (b) removing the first horn from the apparatus; and (c) mounting a second horn assembly comprising an intermediate pipe segment in fluid communication with a casing horn to the apparatus. The first horn is configured and sized to flow product therethrough and to cooperate with the apparatus to form and/or guide seamed casing material thereabout. In operation, the second horn assembly is configured to be in fluid communication with the filler pump for flowing product therethrough and the casing horn is configured to hold non-seamed casing material thereon.

In particular embodiments, the casing horn can have opposing first and second ends with the second end terminating into a horn rotor assembly. The mounting the second horn assembly to the apparatus can include: (a) attaching the horn rotor assembly to the apparatus; (b) mounting the casing horn to the horn rotor assembly; and (c) pivoting the casing horn generally horizontally (so that the discharge end is closer to an operator or user). In addition, the horn rotor assembly can include a support leg attached thereto and the apparatus can include a leg support bracket fixed thereto. The attaching step can be carried out by sliding the support leg into the leg support bracket.

Other embodiments are directed to apparatus with interchangeable horns for engaging with a filler/product pump and supplying elongate casings for encasing products therein. The apparatus includes: (a) a housing having a support structure and opposing upstream and downstream end portions; (b) a first horn releaseably mountable to the housing support structure, the first horn having a length, an outer surface and an internal flow channel therein; and (c) a horn rotor assembly releasably mountable to the housing support structure, the horn rotor assembly comprising a pivotable casing horn with an outer surface and an intermediate pipe segment, each having a respective internal flow channel therein. In operation, the first horn is configured to direct casing material to travel over the outer surface while product travels through the internal flow channel when the first horn is in position. Alternatively, in operation, with the second horn in position, product travels through the intermediate flow channel into the pivotable casing horn while the casing horn directs a supply of casing material to travel over the outer surface thereof.

The first horn may be a heat seal horn configured to cooperate with sheet roll stock to form seamed elastomeric tubular casing *in situ* and the casing horn can be configured to hold and release slugs of shirred fibrous casing material. The apparatus can include means for forming and sealing planar elastomeric (*i.e.*, polymeric) sheet stock disposed in the housing.

In certain embodiments, the horn rotor assembly has an overall assembled length that includes the lengths of the casing horn, pivot head and intermediate pipe segment with the overall length being substantially the same as the first horn length.

Still other embodiments are directed to horn rotor assemblies. The horn rotor assemblies include: (a) a pivot head having a flow passage extending therethrough;

and (b) an elongate casing horn having opposing first and second end portions, an outer surface and an internal flow channel. The second end portion is attached to the pivot head so that casing horn is pivotable.

In particular embodiments, the casing horn and pivot head are configured to allow the casing horn to pivot from side-to-side and/or laterally outward while held in a substantially horizontal or level configuration with the casing horn flow channel and pivot head flow passage in fluid communication. The horn rotor assembly can also include a support member attached to the pivot head. In addition, the horn rotor assembly can include a protrusion member mounted to the pivot head and configured to align with a proximity sensor when in operative position to thereby identify that the casing horn and/or pivot head are in proper operative position.

In particular embodiments, the pivot head comprises a coupling member that can have a semi-spherical profile that is held in a socket member and the socket member can be configured to snugly receive the coupling member while allowing the coupling member to pivot relative thereto.

Other embodiments are directed to kits for modifying an apparatus that produces tubular casings from roll-stock to output non-seamed casings. The kits can be supplied as a retrofit or upgrade option and the like. The kits include: (a) a casing horn and an intermediate pipe segment; and (b) a bracket configured to mount to the apparatus and hold the casing horn and/or intermediate pipe segment with respect thereto.

In certain embodiments, the casing horn in the kit is attached to a pivot head and is configured to pivot (typically from an installation or outwardly extending axially offset configuration to an operative axially aligned position). The kit may optionally include a tension clip attachable to the casing horn and configured to hold an end portion of a slug of fibrous casing material for cooperating with a limit switch to automatically identify when a length of fibrous casing material is expended.

Still other embodiments are directed to computer program products for operating an apparatus that releaseably mounts a plurality of different selectable horns to supply different casing material and fill the selected casing material to provide an encased elongate product. The computer program product includes a computer readable storage medium having computer readable program code embodied in the medium. The computer-readable program code includes: computer readable program

code configured to provide a plurality of different predetermined operational modes of an apparatus that releaseably mounts first and second horns with different horn configurations to supply different casings and a flowable product; and computer readable program code that selects one of the different operational modes responsive to whether a first horn with a first casing material or a second casing horn with a second casing material different from the first casing material is in communication with the apparatus.

In certain embodiments, the computer product can include computer readable program code that accepts user input to identify the type of casing material selected for deployment and/or a selection of operation with either the first or second horn. In addition, the computer program product may include computer readable program code configured to inhibit operation until the selected horn is in proper operative position.

Still other embodiments are directed to systems for producing encased products using selectable first and second horns to thereby produce products in selectable different casing types. The systems include: (a) an apparatus having a releaseably mountable first horn that, in operation, is configured to be in fluid communication with a filler pump located upstream thereof, the first horn configured and sized to flow product therethrough and to cooperate with the apparatus to form and/or guide seamed casing material thereabout; and (b) means for mounting a second horn assembly comprising an intermediate pipe segment in fluid communication with a casing horn to the apparatus. In operation, the second horn assembly is configured to be in fluid communication with the filler pump for flowing product therethrough and the casing horn is configured to hold non-seamed casing material thereon.

These and other objects and/or aspects of the present invention are explained in detail in the specification set forth below.

Brief Description of the Drawings

Figure 1A is a front view of a sealing apparatus configured to hold and/or engage interchangeable horns (shown with an elastomeric casing horn) according to embodiments of the present invention.

Figure 1B is a side perspective view of a releasably attachable elastomeric casing horn shown in **Figure 1A** according to embodiments of the present invention.

Figure 2A is a front view of the apparatus of **Figure 1A**, but shown holding a different horn from that shown in **Figure 1A** (shown holding a horn rotor assembly), according to embodiments of the present invention.

Figure 2B is a side perspective view of a horn rotor assembly that is shown held in the apparatus shown in **Figure 2A** according to embodiments of the present invention.

Figure 2C is a front perspective view of a sealing apparatus of **Figure 2A** shown with a housing cover in position according to embodiments of the present invention.

Figure 3 is a flow chart of operations that can be carried out according to embodiments of the present invention.

Figure 4 is an enlarged top view of the horn rotor assembly shown in **Figure 2B** shown in an exemplary casing load configuration where the casing head can pivot generally horizontally outwardly according to embodiments of the present invention.

Figure 5A is an enlarged partial side perspective view of the horn rotor assembly shown in **Figure 2B** with a support leg held in a bracket according to embodiments of the present invention.

Figure 5B is an enlarged partial side perspective view of the horn rotor assembly shown in **Figure 2B** mounted to the apparatus of **Figure 2A** according to embodiments of the present invention.

Figure 6A is a side perspective view of the bracket shown in **Figure 5A** according to embodiments of the present invention.

Figure 6B is a side perspective view of the bracket shown in **Figure 5A** mounted to the structures attached to the sealing apparatus shown in **Figures 1A** and **2A** according to embodiments of the present invention.

Figure 7A is a side perspective view of a coupler and/or bushing that pivotably connect the device of **Figure 4** to the apparatus shown in **Figure 2C** according to embodiments of the present invention.

Figure 7B is a side view of the coupler shown in **Figure 7A**.

Figure 7C is a side view of an alternative embodiment of a coupler that may be used to connect the casing horn to the apparatus shown in **Figure 2A**.

Figure 7D is a side perspective view of an adapter suitable for use with the coupler of **Figure 7C** and the casing horn as shown in **Figure 2A.**

Figure 8A is a side perspective view of a ball joint or socket that is sized and configured to hold the coupler of **Figure 7A** according to embodiments of the present invention.

Figure 8B is an enlarged front perspective view of the joint or socket shown in **Figure 8A**.

Figure 9 is an enlarged top view of the pivot head and horn rotor assembly shown in **Figure 2A** according to embodiments of the present invention.

Figure 10 is a front view of a shirred voiding/clipping apparatus with the horn rotor assembly in alignment therewith according to embodiments of the present invention.

Figure 11 is an enlarged partial side perspective view of the horn rotor assembly in position with the voiding plates shown in **Figure 10** according to embodiments of the present invention.

Figure 12 is a block diagram of a data processing system according to embodiments of the present invention.

Figure 13 is a flow chart of operations that may be carried out according to embodiments of the present invention.

Detailed Description

The present invention will now be described more fully hereinafter with reference to the accompanying figures, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout. In the figures, certain layers, components or features may be exaggerated for clarity, and broken lines illustrate optional features or operations unless specified otherwise. In addition, the sequence of operations (or steps) is not limited to the order presented in the claims unless specifically indicated otherwise. Where used, the terms "attached", "connected", "contacting", "coupling" and the like, can mean either directly or indirectly, unless stated otherwise. The term "concurrently" means that the operations are carried out substantially simultaneously.

In the description of the present invention that follows, certain terms are employed to refer to the positional relationship of certain structures relative to other structures. As used herein, the term "front" or "forward" and derivatives thereof refer

to the general or primary direction that the filler or product travels in a production line to form an encased product; this term is intended to be synonymous with the term "downstream," which is often used in manufacturing or material flow environments to indicate that certain material traveling or being acted upon is farther along in that process than other material. Conversely, the terms "rearward" and "upstream" and derivatives thereof refer to the directions opposite, respectively, the forward and downstream directions.

The present invention is particularly suitable for producing encased products that may also employ closure clips to seal products held in the casings. The product may be a linked chain of elongated extruded product held in a casing. The casing can be any suitable casing (edible or inedible, natural or synthetic) such as, but not limited to, collagen, cellulose, plastic, elastomeric and/or polymeric casing. Typically, a first horn is configured to form seamed tubular casings from an elastomeric and/or polymeric sheet and/or planar roll stock that is then stuffed or filled with flowable product. A second horn can supply a natural and/or edible (typically fibrous) casing onto the product. More typically, the elastomeric and/or polymeric sheet is a relatively thin sheet (or film) of roll-stock that can be formed *in situ* into a continuous length of heat-sealed and/or otherwise joined or seamed tubular casing. The forming can be carried out substantially automatically and continuously over a desired interval (typically between at least about 45-60 minutes, depending on the size of the length of the roll stock). The seaming can be performed using a heat seal as is conventional and/or ultrasonic, adhesive, light (ultraviolet or other desired wavelength), chemical, and/or other sealing means as is suitable. The seam can be a flat, fin, or other overlapping and/or abutting joint configuration.

The encased elongated or tubular product can be an elongated food product, typically a meat product. Exemplary meat products include, but are not limited to, strands of meat (that may comprise pepperoni, poultry, and/or beef or other desired meat), and processed meat products including whole or partial meat mixtures, including sausages, hotdogs, and the like. Other embodiments of the present invention may be directed to seal other types of food (such as cheese) or other product in casing materials. Examples of other products include powders such as granular materials including grain, sugar, sand and the like or other flowable materials including wet (similar to that held conventionally in cans) pet food or other powder,

granular, solid, semi-solid or gelatinous materials. The product may be a packaged in any suitable industry including food, aquaculture, agriculture, environment, chemical, explosives, or other applications.

As will be discussed further below, the first and second horns can serially cooperate with a shirred voiding/clipping apparatus located downstream of the respective horn to produce an elongated product can be produced in a linked chain of tubular or chub product with clips applied at desired intervals. The length and diameter of each link or chub as well as the overall length of the chain can vary depending on the type of product being produced. Examples of typical strand or chain lengths are between about 1-6 feet. *See, e.g.*, U.S. Patent Nos. 3,543,378, 5,167,567, 5,067,313, and 5,181,302, the contents of which are hereby incorporated by reference as if recited in full herein.

Turning now to **Figure 1A**, an exemplary apparatus or system **10** configured to form seamed tubular casings is shown. The apparatus **10** includes a first horn **20** which cooperates with forming and sealing mechanisms held therein to convert flat roll stock material into tubular seamed casing as the material travels in the apparatus **10** and over the horn **20**. Examples of tubular casing forming apparatus and an associated heat-sealing horn are described in U.S. Patent Nos. 5,085,036 and 5,203,760, the contents of which are hereby incorporated by reference. However, as stated above, the apparatus may be configured to produce the tubular casings using additional and/or alternative joining or seaming means.

As shown in **Figure 1A**, the first horn **20** is in fluid communication with a filler/product pump and supply **15** located upstream thereof as shown schematically in this figure. The first horn **20** includes an internal flow channel **21** that extends through the horn **20**. In operation, the flow channel **21** directs product to flow therethrough (sealed from the environment). As the product exits the discharge end **20e** of the horn **20**, it is stuffed into or fills the casing material that is held around the outer surface of the horn **20**. In the embodiment shown, the horn **20** has an axially extending center line **20c**, a height H_1 above the floor to the centerline **20c**, an overall length L_1, and a length L_2 for the portion of the horn that extends beyond the downstream wall of the apparatus **10**. The horn **20** can be positioned in the apparatus **10** on support structures **10f** so that it is substantially horizontal with the centerline aligned with upstream and downstream components during operation.

Figure 1B shows the first horn **20** separate from the apparatus **10**. The first horn **20** typically includes a forming shoulder **23** on an upstream end portion that guides and/or shapes roll stock (not shown) to substantially conform to the shape of the tubular horn as the material travels away from the forming shoulder and hence wrap the elastomeric or other desired material around the horn **20**. As shown, a guide and/or pre-sizing ring **24** can be held on the horn proximate the discharge end **20e** to help provide the desired tension/size on the casing as it encases the product. Typically, the casing material travels over the outermost perimeter of the guide **24** as is known to those of skill in the art, as the casing material is drawn downstream.

Figure 2A illustrates the apparatus **10** in communication with a second horn **32** and related components. As shown, the second horn configuration is a second horn assembly **30** including an intermediate pipe segment **34**, a pivot head **33**, and a casing horn **32**. The second horn assembly **30** includes an internal flow channel therethrough **32f** (*i.e.*, a sealed channel extending through the respective intermediate pipe segment **34**, pivot head **33**, and casing horn **32**). The pivot head **33** and casing horn **32** can form a horn rotor assembly **35**. The pivot head **33** can include a coupler **44** and socket **45** that are held together (shown with bolts **33b**) in a manner that allows the desired pivotal movement. Other joining configurations may be used to hold the coupler **44** and socket **45** together as will be known to those of skill in the art. The second horn assembly **30** is typically configured to run with different casing (non-seamed or slugs) materials. For example, the second horn **32** may be configured to serially receive and output lengths of shirred fibrous casings.

The intermediate pipe **34** can be held in the apparatus on suitable support structure **10f** and may be clamped at one or more locations with clamps $\mathbf{37_1}$, $\mathbf{37_2}$. Although shown with two clamps other numbers of clamps (or none) may be used as appropriate to stabilize and/or hold the pipe in its operative position during operation. As shown, the intermediate pipe **34** can be configured and aligned to have a centerline **34c** that is substantially same as the first horn **20** when it is held in the apparatus **10**. Similarly, in operative position, the second (casing) horn **32** can also have the same centerline location as that of the first horn **20**. As such, in certain embodiments, the height H_1 of each of the first and second horns **20, 32**, respectively can be substantially the same when held in operative position. In addition, the overall length L_T of the second horn assembly **30** may be substantially the same as the length L_1 of

the first horn **20** (typically within about 5 inches, and more typically within about 2 inches). That is, the assembled length of the second horn assembly including the casing horn **32**, the pivot head **33**, and the intermediate pipe **34** can be substantially the same as the length L_1 of the first horn L_1. Configuring the second horn assembly **30** and the first horn **20** to have substantially the same length can reduce any equipment spacing adjustments required for upstream and/or downstream equipment to allow for a more modular interchange without unduly disrupting existing product lines and/or to use substantially the same floor layout and space to change over from tubular film casing to shirred slug casing over the reverse.

In particular embodiments, the intermediate pipe segment **34** can extend substantially the entire axial length of the housing **10h**. An exemplary range of lengths include an intermediate pipe segment **34** of about 49-51 inches, an overall length L_1 of the first horn **20** may be about 94-97 inches, and the overall length L_T of the second horn assembly **30** may be about 92-95 inches.

The apparatus **10** can include a processor that is configured with dual run modes to selectively run either type of casing material as desired as will be discussed further below.

Figure 2A illustrates that, in certain embodiments, the apparatus **10** can include a bracket **10b** or other mounting means disposed on a downstream side of the housing **10h**. The bracket **10b** can be installed as a retrofit/upgrade component or installed as part of the OEM original equipment on the apparatus **10**. The bracket **10b** and/or other mounting structure can be configured to hold a support member **36** on the horn rotor assembly **35** to support the second horn assembly **30** downstream of the intermediate pipe segment **34**. In other embodiments, the casing horn **32** can mount directly to a downstream apparatus **100** as shown for example in **Figure 10** with mount **136** and any extension pipe(s) or spacers **39** as required for proper spacing between the apparatus **100** and apparatus **10**.

Figure 2A also illustrates a tension clip **40** typically attachable to the pivot head **33** and/or a trailing edge or end portion of a slug of fibrous casing material for cooperating with a lead **40L** attached to a limit switch **40s** to automatically identify when a length of fibrous casing material is expended. The tension clip **40** may mount to the pivot head **33** or other desired mounting structure on one end and clip to the casing material on the other.

Figure 2B illustrates the second horn assembly **30** apart from the apparatus **10**. As shown, the second horn assembly **30** may also include a manual lever that allows a technician or operator to manually trip the limit switch **40s** as the casing material is expended or exhausted. **Figure 2B** also illustrates that the horn rotor assembly **35** may also include a protrusion **46** (shown as a tongue or plate) that cooperates with a proximity switch that automatically confirms when the casing horn **32** and pivot head **33** are in proper operative position. As shown in **Figure 4**, the casing horn **32** can be angled laterally away (side-to-side) from the axial position during loading of shirred casing material. The casing horn **32** may the pivot to a desired (axially aligned) operative configuration. Thus, upon alignment, the protrusion **46** cooperates with a proximity switch, which confirms the proper configuration and position of the casing horn **32** and pivot head **33**. The proximity switch **146 (Figure 5B)** may be magnetic (and the protrusion formed of and/or coated with a magnetic material), optical, inductive or other suitable position detection system. Other electronic or electromechanical position detection systems may also be used.

The pivot head **33** includes a coupler **44** and a socket **45** that receives and holds the coupler **44** and allows the casing horn **32** to pivot. In addition, the horn rotor assembly **35** illustrated in **Fig. 2A** and **2B** includes an (optional) adapter **43** with the pivot head **33**. **Figures 2C** and **4** illustrate the second horn assembly **30** without the adapter **43**. The adapter **43** may be used where a larger pivot head **33** is employed with a smaller casing horn **32** as will be discussed further below.

Figure 2C illustrates the housing **10h** with a cover in position and the intermediate pipe segment **34** extending out of a window **10a** to attach to the horn rotor assembly **35** and/or pivot head **33**.

Figure 3 illustrates operations that may be carried out according to embodiments of the present invention. As shown, when changing over a heat-seal apparatus from a heat-seal horn to the casing horn, the heat seal horn is removed from the apparatus (**block 101**). The upstream or incoming (product or filler) pipe may be disconnected before the heat seal horn is removed (*i.e.*, loosening or removing the clamp connecting the two) (**block 102**). The horn rotor assembly having a pivotable casing horn can be mounted to the heat-seal apparatus. The intermediate pipe

segment can be mounted to the heat-seal apparatus so that the intermediate pipe segment is in fluid communication with the pivotable casing horn (**block 120**).

The horn rotor assembly can be mounted by inserting a horn rotor support leg into a bracket on the heat seal apparatus (**block 111**). The casing horn can pivot to angle laterally in a generally horizontal plane (*i.e.,* side to side), away from the axial centerline during at least one of installation, reloading of (shirred) casing material, and/or removal (**block 112**). The casing horn can be in fluid communication with and/or connect to the intermediate pipe segment and the casing horn can pivot into a substantially horizontal axially aligned configuration during operation and (**block 114**).

In particular embodiments, referring first to **Figures 1A** and **2C**, the cover **10c** on the housing **10h** is lifted, a horn clamp **22** removed and the first horn **20** lifted up and out of the apparatus **10** (the first horn may weigh about 50 lbs or even more). The horn rotor assembly **35** with the pivot head **33** and the horn rotor support member **36** can be positioned in the bracket and secured using a cam style locking clamp **36c** (**Figure 5A**) such as those available from Carr Lane Manufacturing Co., St. Louis, MO. The casing horn **32** can then be attached to the pivot head **33** using an ACME sanitary thread nut for sealing to inhibit product leakage during operation. In other embodiments, the casing horn **32** may be attached to the pivot head **33** prior to mounting the horn assembly/pivot head to the apparatus **10**. As shown in **Figure 4,** the casing horn **32** may be able to pivot to an angle "α" away from the axially extending centerline **30c**. The angle α may be between about 15-75 degrees, and in particular embodiments between about 30-60 degrees. The intermediate pipe segment **34** can be mounted in the apparatus **10** and releaseably secured with clamps or other securing means. The intermediate pipe segment **34** may also be mounted in the apparatus **10** prior to mounting the casing horn **32** and/or rotor assembly **35**. In any event, the upstream piping that connects the intermediate pipe segment **34** to the product/filler pump and/or supply source can be connected.

The pivot head **33** can be configured with surfaces that register in an operative self-sealing configuration where an O-ring, gasket or other sealing means, is seated (such as between the coupler **44** outer surface and the socket **45** inner surface) when the pivot head **33** and casing horn **32** are moved to reside along the axial centerline and are substantially axially aligned. In certain embodiments, an O-ring (not shown)

can reside in a groove **44g** in a rearward portion of the coupler **44** as shown in **Figures 7B, 7C** and seal a flow channel extending through the socket **45** and coupler **44** to the casing horn **32**.

Figures 4 and **5A** illustrate a lateral pivot axis **33a** for the casing horn **32** that allows the casing horn **32** to be moved side-to-side (rotated outwardly to load the desired casing material and inwardly to run). The casing horn **32** may, in certain embodiments, also pivot outwardly (or inwardly) out of axial alignment during installation/removal during changeover to the other horn type. In certain embodiments, the pivot movement may be restricted when mounted so as to substantially freely pivot toward an accessible first side but substantially impeded in pivoting with a corresponding angular motion toward the opposing side by the mounting hardware/apparatus. **Figure 5B** illustrates an example of a proximity switch **139** that cooperates with the protrusion **46** on the pivot head **33** and/or horn rotor assembly **35**.

Figure 6A illustrates one configuration of a bracket **10b** that is sized and configured to receive the horn rotor assembly support member **36**. **Figure 6B** illustrates that the bracket **10b** can be configured to hold the limit switch **40s** and the proximity switch **139** as well as the claiming structure **36c**. The bracket **10b** may be configured to receive an arm extension **10e** attachable to the apparatus **10** so that it is positioned downstream thereof a desired distance.

Figures 7A and **7B** illustrate one embodiment of a coupler **44**. As shown, the coupler **44** has opposing rearward and forward portions, **44_1**, **44_2**, respectively, with a flow channel **44f** extending therebetween. The coupler **44** also includes a groove **44g** on the rearward portion **44_1**. The coupler **44** also includes apertures **44a** sized and configured to receive bolts **33b** or other mounting hardware (screws or other attachment means) to secure the coupler **44** to the socket **45**. The apertures **44a** may not be through apertures, *i.e.*, have a length that is less than the thickness of the material thereat, so as to maintain a sealed cavity region thereunder.

As shown, in certain embodiments the coupler **44** may have a substantially semi-spherical profile with a planar rearward edge **44e** and substantially open cavity and that provides the flow channel **44f**. The coupler **44** may also include a depression region **44d** on a portion of the outer surface and a lip **46m** with two proximate mounting apertures **44p** that can abut and hold the protrusion member/plate **46**

(**Figures 2B**, 4). The forward edge portion **44_2** can include internal ACME threads that engage threads on the casing horn **32** to seal the connection therebetween (*see, e.g.,* **Figure 4**).

Figure 7C illustrates another embodiment of the coupler **44**. In this embodiment, the coupler **44** includes a forward extension **144** that is configured and sized to receive an adapter **43 (Figures 5A, 7D)**. The forward extension **144** can include threads that engage with mating threads on the rearward edge of the adapter **46 (Figure 5A)**. The adapter **43** may have threads **43t** on the inner surface (I.D.) thereof while the forward extension **144** can include corresponding mating threads **44t** on its outer surface (O.D.). The thread patterns are not shown in **Figure 7C, 7D**. The adapter **43** may include flat regions **43f** to allow a tightening tool (*i.e.*, wrench) easier contact and engagement to tighten the connection for proper sealing.

Figure 7D illustrates an exemplary embodiment of the adapter **43** which includes opposing rearward and forward portions **43_1, 43_2**, respectively and a flow channel **43f** extending therebetween. As shown, the adapter **43** has a first diameter on the forward portion **43_2** and a larger diameter on the rearward portion **43_1**.

In certain embodiments, the casing horn **32** can be supplied in incremental sizes, typically between about 1-3 inch (O.D.) configurations and/or a larger size configuration, typically about a 4-inch configuration. Each size generally corresponds to a desired product size and/or casing type. One horn rotor assembly **35** and/or pivot head **33** can be configured to accommodate several different sizes of casing horns **32** such as each of the 1-3 inch configurations, while a separate 4-inch horn assembly **35** may be provided. The adapter **43** can be attached to casing horns in the 1-3 inch range on one end and the 4 inch horn rotor assembly pivot head **33** on the other. Thus, the 1-3 inch adapter expands at the upstream end and can screw into the coupler **44**. However, for a 3-inch pivot head **33**, the casing horn **32** (or corresponding pipe attachment segment) can include female threads on an inner surface thereof that that screw directly onto threads formed on an internal surface of the coupler **44**.

Figure 8A illustrates a socket **45** sized and configured to receive the rearward portion **44_1** of the coupler **44**. As such, the socket **45** includes an internal cavity **45c** having a semi-spherical shape corresponding to the outer profile of the coupler **44**. The socket **45** includes opposing rearward and forward portions **45_1, 45_2**, respectively and a flow entry port **44p** with a relatively short flow channel **45f** that terminates into

the coupler flow channel **44f** during operation. The flow entry port **44p** is in fluid communication with the intermediate pipe segment **34 (Figure 2A)** and pipe extension **39 (Figure 10)**. The socket **45** includes apertures **45a** for receiving bolts or other mounting structures therethrough, to secure the coupler **44** when the bolts **33b** (*see, e.g.*, **Figure 5B**) are in place. The socket **45** can include a mounting bracket **45m** that can releaseably attach to desired mounting structures. **Figure 8B** illustrates a typical operative orientation of the socket **45** mounted to define a generally horizontal pivot axis.

Figure 9 is a top view of the second horn assembly **30** in an operative position proximate the apparatus **10** with the proximity protrusion **46** in position proximate the proximity sensor **139**. In certain embodiments, the apparatus **10** may include an automated horn detector (not shown) that is configured to automatically identify which horn **20, 32** and/or **34** is in use and to automatically select the corresponding run mode operational sequence based on that automatic detection. The detector may include a bar code (infrared) reader held in a location that can communicate with each of the first horn **20** and intermediate pipe segment **34** when in the apparatus **10** and the first horn **20** and intermediate pipe segment **34** have a bar code label fixed in a location corresponding to a reading location. Other detection means can also be used, including, for example, optical recognition sensors (noting the first horn is longer that the intermediate pipe segment), weight sensors, and the like. The detector may also be used to lock out operation if the incorrect horn is in position or if no horn is in position.

Figures 10 and **11** illustrate the second horn assembly **30** in position with respect to an adjacent downstream apparatus **100**. In the embodiment shown, the apparatus **100** is a shirred voiding/clipping apparatus, such as the RS4203 model available from TIPPER TIE®, Tipper Tie, Inc., Apex, N.C. In operation, as is known to those of skill in the art, a skin brake sits on the downstream end portion of the horn which is positioned to be in communication with the apparatus **100** so as to cooperate with voiding plates **300** that allow clips to be attached to a voided casing region at desired intervals. The skin brakes (not shown) can be provided as internal or external skin brakes, recessed or flush mounted, and in sizes corresponding to the horn sizes (*i.e.*, 1-3 inches in ½ inch increments and 4 inches). A sizing ring may be positioned under the casing on the forward edge portion of the horn outer surface to help provide

a more uniform tensioning of the casing. The spacing and lengths of horns may be adjusted based on the type of skin break employed, the size of the horn (length and diameter), the type of product desired, and/or the casing type employed. Examples of exemplary devices and apparatus used to void, clip or tension casing material are described in U.S. Patent Nos.: 4,847,953; 4,675,945; 5,074,386; 5,167,567; and 6,401,885, the contents of which are hereby incorporated by reference as if recited in full herein. A sprayer can be positioned proximate the skin brake (on a downstream portion of whatever horn is in use) to dispense a suitable lubricant such as an oil including glycerin and/or mineral oil (not shown).

In operation, the encased product can be fed to the voiding/clipping apparatus **100** that can be configured to produce a series of single products or a series of chained encased products using either of the two types of casings. A clip can be applied to the beginning portion of a casing, food is pumped into the casing, and the filled casing is moved downstream from the filling point adjacent the discharge end of the horn. The filling can be interrupted momentarily while excess product is voided (pushed away from a clip zone on the package) and two clips can be applied concurrently to the casing at proximate but spaced apart lateral locations in the clip zone. A knife is used to separate the casing between the two concurrently applied clips to produce a sealed single package. This region between the two clips is sometimes described as the "tail" or end of the package. The first or forwardmost of the two clips forms the end of the forward (first) sealed product and the second or rearwardmost of the two clips forms the beginning of the next upstream package, which is now ready for filling which is restarted.

Sometimes, similar to the shirred single piece production method, two clips can be applied concurrently to a voided casing region, which action is repeated a number of times before cutting any of the links to generate a series or chain of linked "chubs." Thus, in operation, a desired number of chubs can be serially produced to form the desired length of product or number of chubs. This process can be described as a "chubbing operation." After the desired length of product and/or number of chubs is generated, the casing is voided and the two clips are concurrently applied to the casing as described above. The knife is then directed to cut the chain at the tail and start a new chain of linked product. The linked or chained products are typically vertically suspended together for further processing. *See, e.g.*, U.S. Patent Nos.

3,543,378, 5,167,567, 5,067,313, and 5,181,302, the contents of which are hereby incorporated by reference as if recited in full herein.

Generally stated, clips can be applied to the casing material to wrap around and close or seal the product therein. The seal formed by the clip against the casing may be sufficiently strong so as to be able to hold a vacuum of about 16mm Hg for about 24-48 hours. Examples of suitable clips include metallic generally "U" -shaped clips available from Tipper Tie, Inc., in Apex, North Carolina. Other clips, clip materials and clip configurations may also be used.

Figure 12 is a block diagram of exemplary embodiments of data processing systems that illustrates systems, methods, and computer program products in accordance with embodiments of the present invention. The processor **410** communicates with the memory **414** via an address/data bus **448**. The processor **410** can be any commercially available or custom microprocessor. The memory **414** is representative of the overall hierarchy of memory devices containing the software and data used to implement the functionality of the data processing system **405**. The memory **414** can include, but is not limited to, the following types of devices: cache, ROM, PROM, EPROM, EEPROM, flash memory, SRAM, and DRAM.

As shown in **Figure 12**, the memory **414** may include several categories of software and data used in the data processing system **405**: the operating system **452**; the application programs **454**; the input/output (I/O) device drivers **458**; the Dual Mode Run Selection Module for selecting the operational sequence associated with the casing and/or horn type in use **450**; and the data **456**.

The data **456** may include a look-up chart of different casing run times (*i.e.*, shirred slugs of casing for the second horn or tubular elastomeric (polymer) casings formed *in situ*, as well as the product, filling rates, selectable chain lengths and link lengths and the like **451** corresponding to particular or target products for one or more producers. The data **456** may include data from a proximity sensor and/or exhaustion of casing material detector that allows the computer program to automatically control the operation of the apparatus to inhibit discharging product when casing material has been expended.

As will be appreciated by those of skill in the art, the operating system **452** may be any operating system suitable for use with a data processing system, such as OS/2, AIX, DOS, OS/390 or System390 from International Business Machines

Corporation, Armonk, NY, Windows CE, Windows NT, Windows95, Windows98 or Windows2000 from Microsoft Corporation, Redmond, WA, Unix or Linux or FreeBSD, Palm OS from Palm, Inc., Mac OS from Apple Computer, LabView, or proprietary operating systems. The I/O device drivers **458** typically include software routines accessed through the operating system **452** by the application programs **454** to communicate with devices such as I/O data port(s), data storage **456** and certain memory **414** components and/or the dispensing system **420**. The application programs **454** are illustrative of the programs that implement the various features of the data processing system **405** and preferably include at least one application which supports operations according to embodiments of the present invention. Finally, the data **456** represents the static and dynamic data used by the application programs **454**, the operating system **452**, the I/O device drivers **458**, and other software programs that may reside in the memory **414.**

While the present invention is illustrated, for example, with reference to the Dual Mode Run Selection Module **450** being an application program in **Figure 12**, as will be appreciated by those of skill in the art, other configurations may also be utilized while still benefiting from the teachings of the present invention. For example, the Module **450** may also be incorporated into the operating system **452**, the I/O device drivers **458** or other such logical division of the data processing system **405**. Thus, the present invention should not be construed as limited to the configuration of **Figure 12**, which is intended to encompass any configuration capable of carrying out the operations described herein.

The I/O data port can be used to transfer information between the data processing system **405** and the downstream voiding/clipping or closure attachment mechanism (such as for chubbed linked product) **420** or another computer system or a network (*e.g.*, the Internet) or to other devices controlled by the processor. These components may be conventional components such as those used in many conventional data processing systems which may be configured in accordance with the present invention to operate as described herein.

For example, the data processing system can be a computer program product with computer readable program code configured to provide a plurality of different predetermined operational modes of an apparatus that releaseably mounts first and second horns with different horn configurations to supply different casings and a

flowable product and computer readable program code configured to select one of the predetermined operational modes responsive to whether a first horn with a first casing material or a second casing horn with a second casing material different from the first casing material is in communication with the apparatus.

In particular embodiments, the computer readable program code is configured to accept user input to identify the type of casing material selected for deployment and/or a selection of the operational mode with either the first or second horn. In addition, the computer readable program code can be configured to inhibit operation until the desired horn is in proper operative position. In certain embodiments, the computer readable program code that inhibits operation comprises computer readable program code configured to obtain and analyze data from a proximity sensor positioned to automatically detect when the second horn is in operative horizontal position.

In addition, the computer readable program code can be configured to automatically identify when a casing supply on the second horn is exhausted. For example, the computer readable program code can be configured to monitor and/or detect when a limit switch is triggered responsive to force applied to a lead attached to a trailing edge portion of the supply of casing material as the trailing edge portion of the casing material advances. In addition, the computer program can include computer readable program code configured to obtain and analyze data from a proximity sensor positioned to automatically detect when the second horn is in operative horizontal position.

In particular embodiments, the computer program can include computer readable program code configured to disregard: (a) the computer readable program code configured to identify when a casing supply on the second horn is exhausted; and/or (b) the computer readable program code configured to obtain and analyze data from a proximity sensor positioned to automatically detect when the second horn is in operative horizontal position, when the second horn is running with the first horn.

In certain embodiments, the computer program can include computer readable program code configure to supply sheet roll stock to the first horn and form the roll stock into a tubular casing configuration *in situ* and/or computer readable program code that allows a manual stop and start to interrupt product flow to feed serially positioned slugs of fibrous casing material on the second horn. In addition, the

computer program can include program code configured to control product flow from a pump positioned upstream of the apparatus to direct the product to flow through one of the first horn or second horn, responsive to which is installed in communication with the apparatus. In particular embodiments, the program can include program code that automatically identifies the desired operational mode by detecting which horn is in position on the apparatus.

Still further, the computer program may include computer program code that cooperates with a shirred casing voiding/clipping apparatus to deliver clips to encased product provided by the first or second horn, depending on which is operative.

While the present invention is illustrated, for example, with reference to particular divisions of programs, functions and memories, the present invention should not be construed as limited to such logical divisions. Thus, the present invention should not be construed as limited to the configuration of **Figure 12** but is intended to encompass any configuration capable of carrying out the operations described herein.

The operation and sequence of events can be controlled by a programmable logic controller. The operational mode can be selected by an operator input using a Human Machine Interface to communicate with the controller as is well known to those of skill in the art. **Figure 13** is a flow chart of exemplary dual run sequence options for an apparatus configured to operate with interchangeable horn types. The series of operations (**225**, **227**, **229**, **231**, **233** and **235**) on the left are associated with the first horn configuration while those on the right (**210**, **211**, **213**, **215**, **217**, **219**, **221** and **223**) are associated with the second horn configuration.

The flowcharts and block diagrams of certain of the figures herein illustrate the architecture, functionality, and operation of possible implementations of selective implementation of single and dual clip closure means according to the present invention. In this regard, each block in the flow charts or block diagrams represents a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified logical function(s). It should also be noted that in some alternative implementations, the functions noted in the blocks may occur out of the order noted in the figures. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may

sometimes be executed in the reverse order, depending upon the functionality involved.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. In the claims, means-plus-function clauses, where used, are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.